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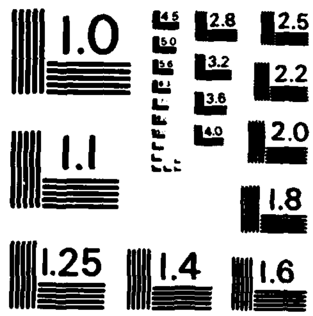


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# FOREIGN TECHNOLOGY DIVISION

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by

Zhang Zhen Xi

FTD-ID(RS)T-0523-83

# EDITED TRANSLATION

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# $Nd^{3+}$:YAG LASER PUMPED SIMULTANEOUSLY BY CW AND PULSED LIGHT

Zhang Zhen Xi

ABSTRACT

This paper describes a new technique in which a $Nd^{3+}$:YAG laser is pumped by CW and pulsed light simultaneously. With compensation of thermal lensing effect, the laser can deliver laser light at low or high repetition rates with desirable stability and lifetime and the advantage of pumping by CW and pulsed light.

We (H. Salzmann, Dr. K. Hirsch, et al.) have completed a new YAG laser which is simultaneously pumped by CW and pulsed light at the Plasma Research Institute of Stuttgart University in West Germany. Now we will introduce this laser from the technical aspect.

This laser uses high pressure krypton lamps in series in a double elliptical light concentrator to pump a YAG rod doped with 1% neodymium. In order to compensate for the thermal lens effect when the input power is 5 kilowatt, the end of the rod was ground into a concave surface with a radius of curvature of 1 meter. The resonance cavity uses a planar and a 1 meter radius of curvature dielectric reflective lens. In order to prevent the overheating of the instrument and the "fatigue" effect, a cooling system which does not fluctuate for more than plus or minus 1 degree was used. Tap water coolant flows through the concentrator, and then cools down the lamp and the rod, respectively. GG17 glass was used to filter out ultraviolet light. The flow rate of the water pump was 35 liters per minute. In order to filter out the impurities in water, the cooling system also employed a microporous filter made of polyvinyl chloride.

The working sequence of the laser is: First the continuous power source is used to light up the lamp. Then, a 20 ampere sustaining current is sent in (input power is about 4.4 kilowatts). Here, the maximum input current is 23 amperes for the continuous power source

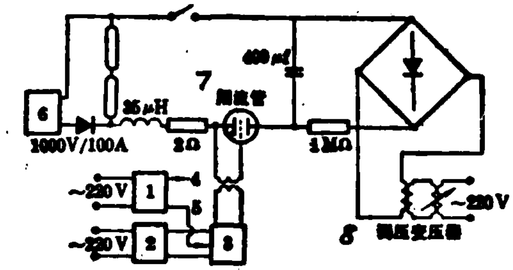


Figure 1. Schematic diagram of the input pulsed energy 1--trigger signal generator (signal 5 to 4, time delay ΔT); 2--3.2 kV power supply; 3--trigger (signal 5 is used to trigger the thyratron); 4--triggering the oscilloscope; 6--continuous laser power supply; 7--thyratron tube; 8--variarc

(the power is approximately 5 kilowatts). Then, a separate pulsed electric power supply system is used to proceed with pumping to create a laser with a pulsed output. The input of the continuous power is to compensate for the thermal lens effect. The output of the laser light is primarily dependent on pulsed pumping. The key of the laser is the selection of the transmissivity of the semi-reflective lens. For a pulsed laser, T should be chosen to be larger. Otherwise, it may cause the continuous output of the laser light. For a continuous output laser, T should be smaller. Furthermore, pulsed pumping will not be continued. The input of the pulsing energy is supplied by a 400 microfarad capacitor group. It is directly connected to the lamp through a thyratron and a mechanical switch (the electrical circuit is shown in Figure 1). Through experiments, it was determined that an electric induction of 200 microhenry and a resistance at 2 ohm in series with the lamp arc resistance of 2.3 ohm can guarantee a nonperiodical current pulse which lasts 1.5 milliseconds. The diode has a protective function with respect to the power source. It prohibits the passage of high voltage. If there is no such diode, high voltage may damage the power source. An oscilloscope has been used to observe that the current waveform measured using a current clamp belongs to the damped attenuation type. We controlled the charging voltage to 900 volts; therefore, the diode parameter was selected to be 1000 V/100A. In order to study the threshold value for the destruction of the lamps, the capacitors have been charged to 2.3 kilovolts (energy stored was 1058 joules). After working several times, one of the lamps was damaged. Therefore, one can see that the lamp damage is directly related to the destructive threshold value, and the degree of fatigue of the lamp.

This laser can emit continuous or pulsed laser beams. It operates reliably. Its conversion efficiency is relatively high. It is easy to adjust. Its lifetime and stability are both ideal. The pumping rate of the pulsed and CW krypton lamp is comparable to the numerical value accomplished by the $Nd^{3+}$:YAG laser pumped by a xenon lamp. It possesses the advantages of the CW and pulsed light pumped lasers. Furthermore, it compensates for the thermal lens effect under the pulsed pumping conditions. This laser was used in the studies of pulsed tuning of Q and small signal gain coefficient. The photograph and data are shown in IEEEJ. Quant. Electr. 1980, QE-16, No. 4439-445. (Northwestern University, Department of Physics, Zhang Zhen Xi manuscript received on October 20, 1980).

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